P3155

Type of Project: New IEEE Standard
Project Request Type: Initiation / New
PAR Request Date: 16 Dec 2021
PAR Approval Date: 23 Feb 2022
PAR Expiration Date: 31 Dec 2026
PAR Status: Active

1.1 Project Number: P3155
1.2 Type of Document: Standard
1.3 Life Cycle: Full Use

2.1 Project Title: Standard for Programmable Quantum Simulator

3.1 Working Group: Programmable Quantum Simulator Working Group(NTC/SC/QuSIM/WG)
3.1.1 Contact Information for Working Group Chair:
Name: Jonathan J. Attia
Email Address: jja@ieee.org
3.1.2 Contact Information for Working Group Vice Chair:
None
3.2 Society and Committee: IEEE Nanotechnology Council/Standards Committee(NTC/SC)
3.2.1 Contact Information for Standards Committee Chair:
Name: Tyler Jaynes
Email Address: tyler.l.jaynes@ieee.org
3.2.2 Contact Information for Standards Committee Vice Chair:
Name: R K Rannow
Email Address: pi-boson@ieee.org
3.2.3 Contact Information for Standards Representative:
None
3.3 Co-Stds Committee(s):
3.3.1 IEEE Computer Society/Standards Activities Board (C/SAB)
Contact Information for Standards Committee Chair:
Name: Kwok Shum Au
Email Address: edward.ks.au@gmail.com

4.1 Type of Ballot: Individual
4.2 Expected Date of submission of draft to the IEEE SA for Initial Standards Committee Ballot: Jan 2024
4.3 Projected Completion Date for Submittal to RevCom: Jan 2025

5.1 Approximate number of people expected to be actively involved in the development of this project: 10
5.2 Scope of proposed standard: This standard defines programming methods of quantum simulators according to analog (i.e., target Hamiltonian), digital (i.e., non-native Hamiltonian evolution) and hybrid (i.e., quantum-quantum or quantum-classical architectures) devices for the simulation of quantum phenomena beyond classical computing applications. This standard includes algorithms to represent the nano-scale properties of quantum simulation devices, and excludes any proposal for the architecture of quantum simulators.

5.3 Is the completion of this standard contingent upon the completion of another standard? No
5.4 Purpose: This document will not include a purpose clause.
5.5 Need for the Project: The quantum simulator (i.e., one controllable quantum system simulates another) has a quantum advantage over classical supercomputers that fail by exponential explosion (i.e., number of parameters grows exponentially with the quantum system size). This new technological paradigm imposes a standard for quantum simulation allowing research and industry to use the full potential of quantum simulation through quantum simulators. Finally, this standard lays the foundation for a disruptive quantum advantage of quantum simulators (by complementing the property of quantum speedup).
5.6 Stakeholders for the Standard: Quantum computer manufacturers, quantum software developers, nanomaterial researchers, energy and pharmaceutical industries, research laboratories.

6.1 Intellectual Property

6.1.1 Is the Standards Committee aware of any copyright permissions needed for this project? No

6.1.2 Is the Standards Committee aware of possible registration activity related to this project? No

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7.1 Are there other standards or projects with a similar scope? Yes

Explanation: Globally, all the existing working groups do not address quantum simulation in their scopes and therefore do not address quantum simulation through quantum simulators. Note that the present standard will collaborate with all existing standards in order to share and harmonize intermediate and final results. More specifically: (i) P3120 proposes a definition of the technical architectures of quantum computers and does not directly address the design methodology of quantum simulations; (ii) P7131 proposes to measure the performance of a quantum computer in terms of quantum speedup, which is not the metric sought in the context of a quantum simulator; (iii) P7130 proposes a nomenclature of quantum computing by building a full stack terminology and does not specifically address the particular environment of quantum simulation; (iv) P2995 characterizes only quantum speedup as a quantum advantage and does not address quantum simulation as a quantum advantage; (v) P1913 proposes a protocol for communication between quantum endpoints and does not address any quantum computing/simulation.

7.1.1 Standards Committee Organization: C/MSC
Project/Standard Number: P3120
Project/Standard Date: 09 Nov 2021
Project/Standard Title: Standard for Quantum Computing Architecture

7.1.2 Standards Committee Organization: C/SAB
Project/Standard Number: P7131
Project/Standard Date: 23 Sep 2021
Project/Standard Title: Standard for Quantum Computing Performance Metrics & Performance Benchmarking

7.1.3 Standards Committee Organization: C/SAB
Project/Standard Number: P7130
Project/Standard Date: 23 Sep 2021
Project/Standard Title: Standard for Quantum Technologies Definitions

7.1.4 Standards Committee Organization: C/S2ESC
Project/Standard Number: P2995
Project/Standard Date: 16 Jun 2021
Project/Standard Title: Trial-Use Standard for a Quantum Algorithm Design and Development

7.1.5 Standards Committee Organization: COM/NetSoft-SC
Project/Standard Number: P1913
Project/Standard Date: 03 Mar 2016
Project/Standard Title: Software-Defined Quantum Communication

7.2 Is it the intent to develop this document jointly with another organization? No

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8.1 Additional Explanatory Notes: